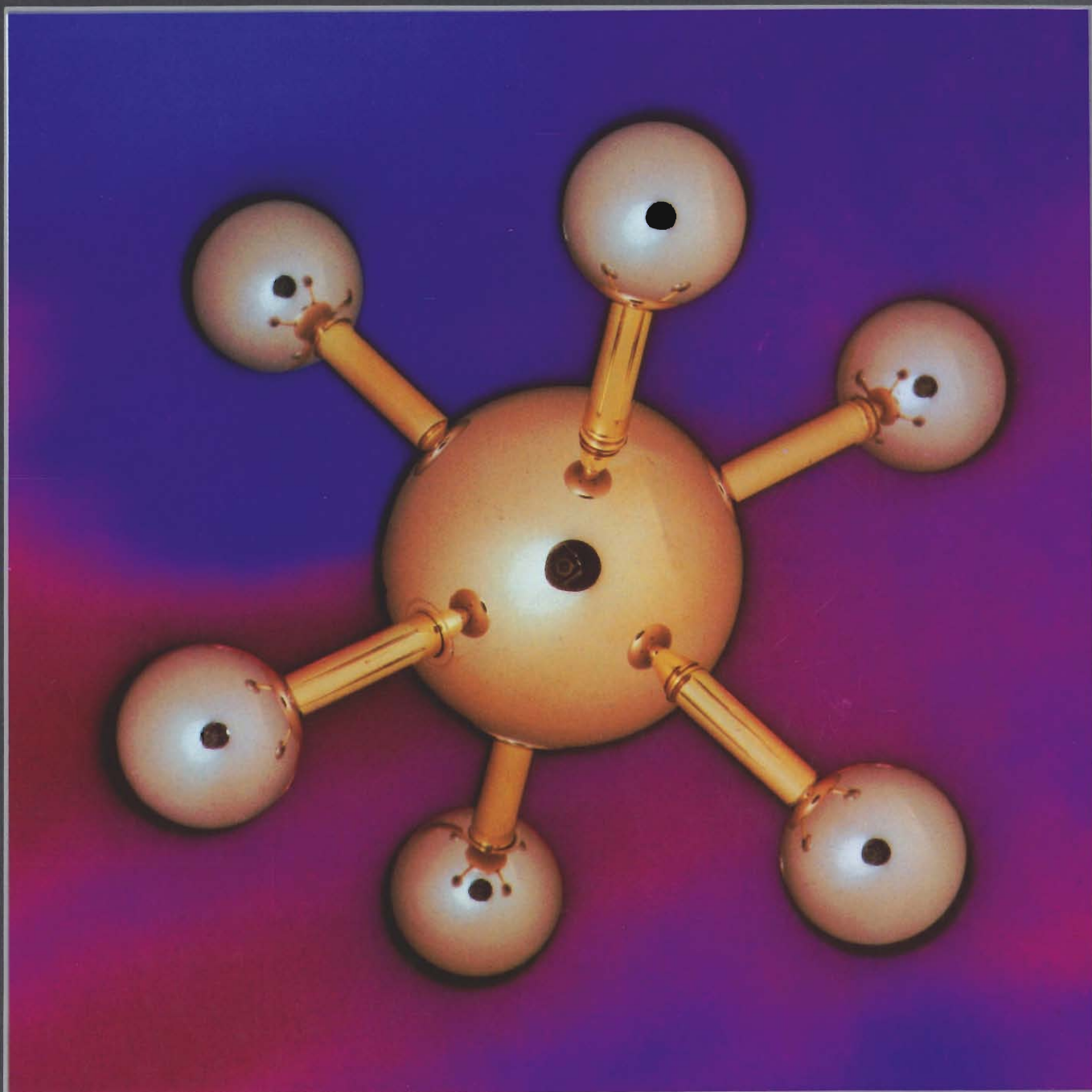


# Los Alamos Science

LOS ALAMOS NATIONAL LABORATORY



## EDITOR'S NOTE

About ten years ago Los Alamos scientists ventured into a new frontier of scientific research, the interaction of lasers with molecules. It was the beginning of laser-induced chemistry—a field that holds much promise for the future.

The initial project that captured the imagination of both the scientists and the funding agencies was a clever scheme to produce enriched uranium. Bypassing the need for huge diffusion plants and their enormous consumption of electrical power, the idea was to use the intense, single-frequency light of lasers to break the chemical bonds of only those molecules containing the fissionable isotope uranium-235. This valuable nuclear fuel, which is only a minor constituent of uranium ore, would thus be prepared easily and cheaply in the more concentrated form required for nuclear reactor applications.

To take this idea, which originally was based almost entirely on intuition rather than experimental fact, and to make it not only work, but also work economically and efficiently, has been a prodigious task and one that is not yet complete. It has required the development of new high-power lasers that now enable chemists to “see” into chemical reactions in somewhat the same way that the microscope enables the biologist to see into the structure of microorganisms. It has required a new and deep understanding of molecular dynamics that has revolutionized the field of infrared spectroscopy. It has required an understanding of the remarkable nonlinear process of multiple-photon excitation whereby molecules absorb light energy much as a sponge absorbs water. And it has required tremendous dedication and perseverance.

Not only have the scientists had to face numerous disconcerting surprises offered up by nature, but they have had to work under the burden of perhaps overzealous classification (in a number of instances, concepts and results that originated at Los Alamos and were classified were later published by others in the open literature) and under the formidable pressure of management milestones—milestones based, perhaps of necessity, more on a priori assumptions rather than on proven facts about how nature works.

At present the program is facing a point of decision. Of three competing processes, the Los Alamos process may or may not be chosen to go forward with an advanced engineering program designed to lead to a demonstration plant. Even as we prepare this issue, Los Alamos scientists are in the laboratory working almost around the clock to show that molecular laser isotope separation will be able to produce the enrichments and the product throughput required to make the process economical. The latest results have come very close to the design parameters specified for a full-scale plant. These results were obtained in part by modifying the laser systems and will therefore affect the proposed plant design. But it is hoped that the decisionmakers will look favorably upon these

changes. Despite the promising results to date, evaluation of the program is clouded by uncertainties in the laser and optical equipment costs. Then too, the future of the program, and in fact of all advanced isotope separation programs, is clouded by the decreasing demand projections for enriched uranium in the United States.

Whatever the outcome of the present competition, Los Alamos is proud of the program's technical achievements. According to the program leaders, the investment in this technology has produced dollar for dollar as much new knowledge, as measured by the number of research papers, as direct funding in basic research. And undoubtedly the related research on laser development and laser-induced chemical reactions has made an enormous contribution to the general field of applied photochemistry.

Perhaps it is fitting that in this issue devoted to a field of high scientific interest, high risk, high promise, and at the moment high drama, we honor Bernd Matthias through a personal memoir by one of his dearest friends. He was a man who loved risk, loved life, and more than anything loved the adventure of science.

*Cover photograph by H. W. Johnson and R. E. Duran*

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*Errata: On page 131 of the article "Keeping Reactors Safe from Sabotage" (Volume 2, Number 1), we erroneously cited Ronald L. Cubitt rather than Richard L. Cubitt.*

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#### On the cover.

*A unique "mirror" for lasers fluoresces as it reflects the phase-conjugate version of an incident laser beam. Ultraviolet light from a xenon fluoride laser enters a cell of liquid hexane from*

*the left. There stimulated Brillouin scattering generates the reflected beam, which exactly retraces, in reverse, the path of the incident beam. (Photo by Henry Ortega)*

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